focus on . . .

Rolling and Forming

The Los Alamos capability for thermomechanical processing of metals is extensive and of long standing. We have processed almost every metallic element on the periodic chart to make prototypical parts and samples for a wide variety of research and development programs. The thermomechanical processing capability is closely linked to the mechanical properties and characterization capability so that the understanding of the influence of strength, texture, etc. can be applied to research on forming problems. Although the capability is used primarily for metals, we also process many interesting composites such as the powder-in-tube (high-temperature) superconducting wires.

Metal forming operations encompass a wide range of techniques, including deep drawing, hydroforming, extrusion, high energy-rate forming (HERF), wire drawing, rolling, swaging, and pressing. We possess a formability tester that offers new and sophisticated possibilities for both precision metal forming and forming research. This machine can function as a hydraulic bulge tester with real-time stress-strain analysis or as a precision press. We are currently applying this machine to formability studies of aluminum alloy sheet in collaboration with an industrial partner.

Friction is a controlling factor in many metal forming processes but has received surprisingly little attention over the years. We have accumulated a significant amount of experience in measuring and predicting friction behavior under metal forming conditions. One of the crucial factors, for example, is the plastic deformation that is taking place at the tool/work-piece interface. Another example of our contribution to metal forming is in the area of anisotropy and texture. We have developed computer codes to analyze textures and predict anisotropy in a very wide range of materials from steel and aluminum to quartz.

The following list provides an overview of the equipment we support in our rolling and forming laboratories.

Wire and tube drawing

Mechanical and hydraulic draw benches provide tube and wire processing from 1.0 to 0.00l inch with turkshead shaping capability. Five swaging machines support die sizes ranging from 0.012 to 1.25 inches and most metals including uranium.

High energy-rate forming

Model 1220 vertical and Model 1800 horizontal Dynapaks provide high energy-rate forming, forging, and extrusion capability.

Hydraulic presses

Several hydraulic presses perform a variety of metal working operations including deep drawing and forging. Available presses include a triple-action Lake Erie press with 5000 ton capacity and over 10 feet of daylight and an 1100 ton (10MN) MTS servo-hydraulic test system.

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Hydroforming press

Deep drawing operations are also performed on a Cincinnati Hydroform with 15-inch diameter blank capacity, 10,000 psi chamber pressure, and a 7-inch stroke.

Rolling mills

Rolling capability is provided by four rolling mills including a 2-high/4-high Stanat mill with 7.75-inch wide rolls, a 4-high Loewy mill with 19.5-inch wide rolls, a 2-high Bliss mill with 19.5-inch wide rolls and a 2-high/4-high Waterbury Farrell mill with 15-inch wide rolls and strip tension capability.

Heat treating

Heat treating capability is provided by several electric resistance air furnaces and two vacuum furnaces. A high-vacuum Brew furnace is capable of over 1600°C in a 15x15x24-inch hot zone with gas cooling. An integral vacuum oil-quench Wellman furnace can heat to 1200°C and quench directly into oil under vacuum in a 24x24x48-inch hot zone.

Recent Publications

D. A. Korzekwa, J. F. Bingert, E. J. Podtburg, and P. Miles, "Deformation Processing of Wires and Tapes Using the Oxide-Powder-In-Tube Method," *Applied Superconductivity* **2** (3/4), 261-270 (1994).

A. J. Beaudoin, P. R. Dawson, K. K. Mathur, U. F. Kocks, D. A. Korzekwa, "Application of Polycrystal Plasticity to Sheet Forming," *Computer Methods in Applied Mechanics and Engineering* **117**, 49-70 (1994).

D. A. Korzekwa, P. R. Dawson, and W. R. D. Wilson, "Surface Asperity Deformation During Sheet Forming," *Int. J. Mech. Sci.* **34** (7), 521-539 (1992).

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